

Lemuel Shattuck—Still a Prophet

The Vitality of Vital Statistics *

HUGO MUENCH, M.D., DR.P.H., F.A.P.H.A.

Professor of Biostatistics, Harvard School of Public Health, Boston, Mass.

SOME hundred years ago, Lemuel Shattuck defined statistics as "the science or art of applying facts to the elucidation and demonstration of truth" (283).† He called it "the basis of social and political economy, and the only sure ground on which the truth or falsehood of theories can be brought to the test."

Shattuck was anticipating (and refuting in advance) objections which would be raised to the fifty recommendations set forth in the *Report of the Sanitary Commission*. Since so much of the *Report* is based on the analysis of vital data in Massachusetts and elsewhere, the expected objection arises very early. The hypothetical Philistine says: "I don't think much of your statistics; you can prove anything by figures." The ring of this is all too familiar to the ears of a statistician, who frequently finds himself in the position of priest of a religion which, alternately reviled by the laity, is again called on by them to pull a prolific rabbit out of a magic silk hat—or, perhaps, in this case it should appropriately be a dunce cap.

Carefully defining what he means by "statistics," Shattuck goes on to point out that they do not consist merely, or even largely, of columns of figures. He uses figures, he says, as the representatives of facts, and as such he finds them

"far more useful and important than the fiction and theory, the assumption and assertion that have occupied so much of public attention."

He very clearly realizes the function of figures in statistics when he says that "combination and deduction are required to give them full effect." The entire *Report* is an excellent example of the intelligent use of numerical data for the deduction of justified conclusions, which is the essential groundwork of a science. A science develops, as a rule, through the advent of minds which can organize recorded knowledge, deduce general relationships, and test them against experience. Such minds are never plentiful: at times a constellation of them arises, to be succeeded by a long sterile period. Shattuck's was one of the earliest of such minds to appear in our science of public health which, after all, is not very old even as measured in terms of recorded history.

Logical thinking has presumably been practised since some remote grandfathers freed their front paws from the chore of walking, or of swinging through trees, and began to use them for the purpose of taking their universe apart to see what made it tick. Even so, most of what we like to call "thinking" is far from logical, and the human race is subject to periodic mass retreats from reason. A Greek Golden Age is followed by a period of medieval obscurity, and a Renaissance of liberal humanitarianism by an eclipse of totalitarian dogma. Yet the night is never com-

* Presented before the American Public Health Association at the Seventy-sixth Annual Meeting in Boston, Mass., November 10, 1948.

† Numbers in parentheses refer to pages of the original *Report*.

pletely black, any more than the day is without shadows. The tools of intellectual progress are always at hand for him who has the ability and the will to use them, and no age is without its examples of illustrious heretics who dared stake and concentration camp to maintain "Eppur si muove!"

One of the most powerful tools of logical reasoning is mathematics, and quite regularly the organization of new knowledge and the departure from accepted beliefs is along the roads of mathematical synthesis and analysis. It should not be surprising that Shattuck's attack on his problem was couched in statistical terms — or, if you prefer, that a statistical mind of high order produced a logically outstanding statement of problems which could, at that time, be seen only indirectly; and propounded a solution so complete in its general terms that we have not yet caught up with all its implications.

For, mind you, there was no bacteriology at the time of the *Report of the Sanitary Commission*. Shattuck speaks, as did the eminent physicians of his day, of exhalations and effluvia, of bad airs and of stinks. Since air is to blame for much "zymotic" disease, he becomes curious about meteorological changes and analyzes them in some detail (143). He recommends that stations be set up to study changes in the weather (no mean task in the Boston area) and to relate such changes to the occurrence of various diseases. He points out that some gases, such as hydrogen sulfide, when present in any appreciable amount are a direct danger to health. This may be regarded as at least an embryonic approach to industrial hygiene.

With the advent of bacteriology, cause and effect of "zymotic" diseases became direct and simple; perhaps too simple. An increasing number of us are wondering today whether the role of meteorology in the epidemiologic picture

has not been too much neglected; whether we might not with profit return to this recommendation of the *Report* and pursue it farther to see whether it could not yield keys to a few of the many doors still locked against us.

Most of the *Report*, being essentially statistical, deals with relationships that can be measured. It may be noted that Shattuck, influenced as he naturally was by current medical speculation, still had the statistician's obstinate reluctance to accept ideas that he could not support with numerical data. He quotes Chadwick, for instance (188), at some length on the dangers of cemeteries to the public health—but he prefaces the quotation with the statement that Massachusetts has not yet experienced these evils; at least to any great extent.

Shattuck's statistical sources were, by today's standards, fragmentary and sometimes of dubious reliability. Yet he seized on them and milked them dry of reliable conclusions, while avoiding many pitfalls into which he might easily have stumbled. Part of his argument is based on average ages at death, but he points out the fallacies underlying comparisons on this basis (106) and is careful to restrict his own conclusions to similar groups. Clergymen, he notes, over a long period of years died at an average age of 63.5; in more recent years, they have been dying, on the average, 7 years earlier (85). Physicians, similarly, have lost 9 years of life compared to earlier periods (86). But he insists, over and over, that the best measure for comparison, when available, is the specific death rate according to age and other factors (139).

The basic argument of the *Report* is simple and straightforward. Mortality conditions were better in Massachusetts in earlier years; some causes are now making them worse; if such causes have been newly introduced, they can be removed, and conditions restored to at least their previous levels.

Various demonstrable factors are associated, in some areas, with mortality rates higher than those of other areas. At least some of these factors can be eliminated and this elimination should bring the higher rates closer to the lower ones.

Again and again, it is pointed out that mortality increases with urbanization. In cities, the increase is associated with crowding and with what we should now call "socio-economic" factors. Infant mortality, in 1830 already twice as great in Boston as in two "country towns," has risen by another half in 15 years more (82). Mortality in other young age groups has kept pace; older people are about holding their own. Why have these mortalities increased? Well, for one thing, "zymotic" diseases have doubled on the scale of proportional mortality. In 1810-1820, they produced 16 per cent of all deaths (90) and, in 1840-1849, 32 per cent (92). Shattuck calls these diseases the "Index of Public Health." Certain of them have increased enormously in Boston, such as smallpox and scarlet fever. The "typhus" fevers, including typhoid, have not increased and, in fact, are relatively more of a problem in the country. Boston has, on the other hand, a much larger share of the dysenteric diseases of childhood (100). Detailed tables are devoted to the analysis of deaths from tuberculosis (94), which not only causes one-seventh to a quarter of all deaths but takes its victims out of the best and most productive part of the life span. It is emphasized that there is no hope of cure, once the disease is established (98)—it must be controlled by prevention.

Why is there this increase in what we should now, in general, call the infectious diseases? For one thing, it is pointed out that known preventive measures have been neglected: the smallpox vaccination laws have been emasculated (180). For another, people

are being herded into smaller and smaller circles. To show the effects of this, English data are quoted (43) showing the relationship of crowding to mortality rates in London. Socio-economic factors are brought in: in Liverpool, even the gentry have a death rate equal to London's worst, or 29/1,000; among workers, it is over twice as high (44) to reach the horrifying figure of 67 persons dying per year in each thousand of the population.

From the Census of Boston, Shattuck takes survivorship curves (102) for various population groups. According to these, overall life expectancy in Newton is similar to that in England, or slightly less. Boston's situation is very much worse while Boston Catholics are very definitely in worse case still. Boston Catholics in those days were, of course, very largely the recently arrived and still economically desperate Irish immigrants. Of them, the *Report* has a great deal to say (200): as the population of Boston becomes more largely foreign born, increased crowding is only one of the bad results. The new citizens contribute more than their share of delinquency and disease, while benefiting out of proportion from school taxes and hospital beds.

In the fifty recommendations for the improvement of health conditions in Massachusetts, it is not surprising to find the need for the provision of vital data eloquently stressed and a system of collection expounded in considerable detail. The twelfth recommendation (126) asks that census information be so gathered and made available as to be of real use to the hygienist. Shattuck says: "An exact knowledge . . . of the living inhabitants . . . is the first . . . element, for estimating their sanitary condition." He then enumerates the facts that should be collected: a list not greatly different from one we might make today (128). He points out one essential: this informa-

tion must be known for each individual, and not pooled in groups (130). He also recommends a more modern system of age grouping than that hitherto employed.

Shattuck finds, as do many of us, that ten years is a long time between censuses. The State Constitution at that time provided for state censuses taken during the same years as the federal ones (133). He points out the absurdity of this and recommends that state censuses be spaced evenly between federal ones: a recommendation since then followed. The blame for the only moderate success of this measure can hardly be laid at Shattuck's door.

In the fourteenth recommendation (135), the need for a comprehensive system of recording vital data is set forth at length. It is pointed out (139) that age-specific death rates are the only fair bases of comparison and that these cannot be found without knowledge of the ages of the population and the ages at which they die. A table is presented (140) illustrating the effect of different population compositions on the crude death rate, and a warning is sounded against the not entirely extinct habit of comparing the salubrity of occupations on the basis of the gross mortalities of the groups involved, without taking into account what differences there may be in the ages of those who work at different tasks. In order to study the natural history of populations, says the *Report*, complete data on births are as necessary as those on deaths, and they should be collected and registered just as carefully.

Shattuck ends this recommendation by a brief statement of twelve principles (141), here even further abridged:

1. Mortality varies uniformly with age.
2. Maintenance of the population is based primarily on the number of married couples in the fertile ages.
3. Excessive births are a *cause*, not a *consequence*, of high mortality rates.
4. Mean age at death and crude death rate

are fallacious measures of health conditions.

5. Comparing the dangers of different occupations on the basis of mean age at death or of total mortality of the workers is fallacious.

6. Previous rates cannot be compared with present ones on these bases.

7. Age-specific death rates form the only legitimate basis for comparisons.

8. Immigration and emigration usually distort the age distribution of a population, and so its crude mortality rate.

9. Morbidity and mortality should be studied separately by age, sex, season, occupation and other factors.

10. An accurate census and accurate vital statistics are basic to knowledge of a population, and a sanitary survey is useless without them.

11. The English system of age grouping should be adopted instead of the present, irregular one.

12. Statistics should be under the supervision of the Board of Health to secure uniformity over the entire State.

We could hardly ask for a more comprehensive statement of why statistics are useful, and what they must include in order not to be misleading. The sixteenth recommendation (149) adds a suggested list of causes of death to supersede the medical classification currently in use, which is considered unsatisfactory. Shattuck feels that the causes of disease deserve more attention than does the disease itself (150), and endeavors to construct a classification according to etiological principles. Although his system of causative agents is based on notions a century old, his principle has a very modern sound: particularly in view of our continued inability to get away from a classification based partly on etiology and partly on regional pathology.

Throughout the *Report*, one is struck by the rarity of occasions on which Shattuck is led very far astray by concepts of disease current in his time, some of which look ludicrous enough from the proud point of view of our present rung on the ladder of epidemiologic knowledge. He is a hard-headed business man, and he insists on facts.

As a business man, also, he abhors

waste in the human population as he would in his publishing house. Unnecessary deaths are a criminal waste. They not only cause misery to the individual concerned and to his family, but they throw helpless widows and orphans on the community and so deplete its resources. Unnecessary illness is much the same. It causes suffering; it also reduces productivity and leads to additional expenses. Lacking adequate morbidity statistics for Massachusetts, Shattuck quotes liberally from English sources (174) as to days lost per year due to sickness. He proposes, in the twenty-fifth recommendation (171), that morbidity surveys be carried on to determine the exact load of disease in Massachusetts. In the meanwhile, he is quite sure that conditions here are worse than in England. His reason is simple and convincing: various sickness insurance companies have been formed in Boston and have used English experience as a basis for their premium rates. They have uniformly gone into bankruptcy (177)! He estimated that, in 1849, at any time, over 5 per cent of Boston's population was sick.

In order to do justice to Shattuck's grasp of statistical method—to show how firmly his conclusions are based on sound quantitative reasoning—almost the entire book would have to be quoted. Did he think logically because he was a trained statistician? Or did he become interested in statistics because he had a logical and orderly mind? The choice of answer does not seem to matter greatly.

What does matter a great deal is that by use of Laplace's "good sense reduced to arithmetic" a man, although not a physician, was able to see the essentials of a complicated question and to postulate a workable answer. Perhaps we should say "*because* he was not a physician," since he was to some extent able to stand outside the body of accepted medical ideas of his time and to view them with a certain disinterest and detachment. The lenses he used to help him see more clearly were statistical in their structure.

Medicine and public health, by their very nature, tend to accept and to carry on ideas based on evidence that is anything but solid. The problems are so great; the needs so immediate; the possibility of experiment so difficult; that we easily succumb to the comfortable feeling that whatever we are doing must be of some benefit to a suffering humanity, and should not be questioned. Once a concept is deeply imbedded in our thinking it requires unusual ability and pertinacity to dig through the surrounding layers of custom and association, to bring the concept to the light of day and to subject it to a new and thorough scrutiny.

True enough, vital statistics alone does not enable the questioner to see clearly, to judge soundly, and to act sensibly. But it is an essential tool for the type of mind which Shattuck had; it will be just as essential to the next who may come to tear down old walls and to build new and better on the solid foundations. That is the vitality of Vital Statistics!

*Order blank for Report of the Sanitary Commission of Massachusetts 1850
by Lemuel Shattuck appears on page XXXVI.*